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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/518,026	12/15/2004	Masayuki Kinouchi	8007-1078	4925

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EXAMINER	
BEST, ZACHARY P	

ART UNIT	PAPER NUMBER
4191	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/518,026	KINOUCHI ET AL.	
	Examiner	Art Unit	
	Zachary Best	4191	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 December 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 December 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *09252006, 03152005, 12152004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

POLYELECTROLYTE MEMBRANE AND PRODUCTION METHOD THEREOF

Examiner: Z. Best S.N. 10/518,026 Art Unit: 4191 May 1, 2008

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-4, 6, 11, 14-17, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al (WO01/86748) in view of Funaoka et al (WO00/20493). (Subsequent reference to Nakagawa et al. and Funaoka et al. are based on corresponding U.S. Patent Nos. 7,029,793 B2 and 6,666,969 B1.)

Regarding Claim 1, Nakagawa et al. teach a polymer electrolyte membrane comprising a microporous membrane (col. 9, lines 29-30), wherein the microporous polymer membrane contains a mixture of a polymer and a molten salt at a weight ratio of 1/9 (col. 18, lines 3-14) and/or a molten salt (col. 10, lines 6-15). However, Nakagawa et al. fail to teach said microporous membrane has pores penetrating through the opposite sides thereof.

Funaoka et al. teach a microporous membrane (abstract) that comprises through-holes in the membrane (col. 5, lines 8-11). It is advantageous to use the through-holes of Funaoka et al. because it retains high permeability (col. 5, lines 12-15). Therefore, it would

have been obvious to one having ordinary skill in the art at the time the invention was made to create the polymer electrolyte membrane of Nakagawa et al. wherein the polymer membrane has pores penetrating through the opposite sides thereof because Funaoka et al. teach that said through-holes will retain high permeability of the polymer electrolyte membrane.

Regarding Claim 2, Nakagawa et al. teach the microporous polymer membrane contains the molten salt (col. 10, lines 6-15).

Regarding Claim 3, Nakagawa et al. teach the microporous polymer membrane holds the mixture of the polymer and the molten salt in the pores thereof (col. 18, lines 3-28).

Regarding Claim 4, Nakagawa et al. teach the microporous polymer membrane holds the mixture of the polymer and the molten salt in the pores thereof and on both sides thereof (col. 18, lines 3-28).

Regarding Claim 6, Funaoka et al. teach the microporous polymer membrane has an average pore size of 0.03-2 μm (col. 5, lines 16-20).

Regarding Claim 11, Funaoka et al. teach the microporous polymer membrane has an overall porosity (percentage of void) of 45-80% (col. 5, lines 21-25).

Regarding Claim 14, Nakagawa et al. teach the molten salt has an ammonium ion as a cation component (col. 6, lines 13-17).

Regarding Claim 15, Nakagawa et al. teach the content of the mixture of the polymer and the molten salt is 1/9 by weight (col. 18, lines 3-14).

Regarding Claim 16, Nakagawa et al. teach the content of the molten salt is 10% by volume (col. 10, lines 6-11, LiBF4 has a volume of 0.11 L/mole).

Regarding Claim 17, Nakagawa et al. teach a process of producing a polymer electrolyte membrane containing a molten salt comprising by infiltrating the molten salt into pores of a microporous polymer membrane comprising immersing the microporous polymer membrane having pores in the molten salt (col. 10, lines 1-15). However, Nakagawa et al. fail to teach said microporous polymer membrane has pores penetrating through the opposite sides thereof.

Funaoka et al. teach a microporous membrane (abstract) that comprises through-holes in the membrane (col. 5, lines 8-11). It is advantageous to use the through-holes of Funaoka et al. because it retains high permeability (col. 5, lines 12-15). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to create the process of producing a polymer electrolyte membrane of Nakagawa et al. wherein the polymer membrane has pores penetrating through the opposite sides thereof because Funaoka et al. teach that said through-holes will retain high permeability of the polymer electrolyte membrane.

Regarding Claim 19, Nakagawa et al. teach a process of producing a polymer electrolyte membrane containing a mixture of a polymer and a molten salt comprising impregnating the microporous polymer membrane having pores in a solution of the mixture of a polymer and a molten salt at a weight ratio of 1/9 and irradiating (drying) the membrane with an electron beam (col. 18, lines 3-14). A solvent may be used in the solution (col. 4,

lines 36-64), and the solvent would dry when the electrolyte became in solid-state (col. 18, lines 13-14). Nakagawa et al. further suggest impregnation by dipping (immersing, col. 10, lines 12-15). However, Nakagawa et al. fail to teach said microporous polymer membrane has pores penetrating through the opposite sides thereof.

Funaoka et al. teach a microporous membrane (abstract) that comprises through-holes in the membrane (col. 5, lines 8-11). It is advantageous to use the through-holes of Funaoka et al. because it retains high permeability (col. 5, lines 12-15). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to create the process of producing a polymer electrolyte membrane of Nakagawa et al. wherein the polymer membrane has pores penetrating through the opposite sides thereof because Funaoka et al. teach that said through-holes will retain high permeability of the polymer electrolyte membrane.

3. Claims 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al. in view of Funaoka et al. as applied to Claim 1-4, 6, 11, 14-17, and 19 above, and further in view of Kim et al. (Solid State Ionics 144 (2001) 329-337).

Regarding Claim 5, Nakagawa et al. and Funaoka et al. teach a polymer electrolyte membrane as recited in Paragraph 2. However, Nakagawa et al. and Funaoka et al. fail to teach said microporous polymer membrane comprises contains the molten salt in the pores thereof and has a layer comprising the mixture of the polymer and the molten salt provided on both sides thereof.

Kim et al. teach a polymer electrolyte for a microporous membrane (abstract), wherein the membrane is coated on both sides with a polymer and soaked in an electrolyte solution to fill the pores (pg. 330). It is advantageous to coat the sides of the membrane because it will encapsulate the electrolyte solution in the porous membrane and further assist in adhering the electrodes to the separator (pg. 330). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to create the polymer electrolyte membrane of Nakagawa et al. and Funaoka et al. wherein the membrane is coated on both sides with a polymer and soaked in an electrolyte solution to fill the pores because Kim et al. teach that encoating the sides with a polymer will encapsulate the electrolyte solution in the porous membrane and further assist in adhering the electrodes to the separator.

4. Claims 7-9 and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al. in view of Funaoka et al. as applied to Claim 1-4, 6, 11, 14-17, and 19 above, and further in view of Narang et al. (U.S. Patent No. 6,248,480 B1).

Nakagawa et al. and Funaoka et al. teach a polymer electrolyte membrane as recited in Paragraph 2. However, Nakagawa et al. and Funaoka et al. fail to teach said microporous polymer membrane comprises a heat-resistant polymer or is a polyimide membrane.

Regarding Claim 7-9, Narang et al. teach a polymer electrolyte separator (membrane) comprising an aromatic polyimide (col. 3, lines 61-67) for use as a high temperature polymer electrolyte (abstract). Therefore, it would have been obvious to one having ordinary skill in

the art at the time the invention was made to create the polymer electrolyte membrane of Nakagawa et al. and Funaoka et al. wherein the microporous polymer membrane comprises a heat-resistant aromatic polyimide because Narang et al. teach that use of an aromatic polyimide allows for increased temperature resistance of the polymer electrolyte separator. Furthermore, while Narang et al. does not specifically teach that the heat-resistant polymer has a glass transition temperature not below 100 °C, the glass transition temperature property is inherent given both Narang et al. and the present application utilize the same polymeric separator. A reference that is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. *In Re Roberston* 49 USPQ2d 1949 (1999).

Regarding Claims 12-13, Narang et al. teach the use of cation exchange groups, specifically sulfonic groups, contained in polymers in the polymer electrolyte separator (col. 4, lines 46-67). It is advantageous to use the sulfonic cation exchange group because it can be coupled to a variety of polymer electrolytes (col. 4, lines 60-67) and it is capable of transitorily and non-covalently binding an ion (col. 3, lines 41-52). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to create the polymer electrolyte membrane of Nakagawa et al. and Funaoka et al. wherein the polymer electrolyte contained a sulfonic cation exchange group because Narang et al. teach the sulfonic cation exchange group can be coupled to a variety of polymer electrolytes and it is capable of transitorily and non-covalently binding an ion. Furthermore, while Narang et al. does not specifically teach the cation exchange group polymer electrolyte has an ion

exchange capacity of 0.3-7 meq/q, the ion exchange capacity is inherent given that both Narang et al. and the present application utilize the same polymeric separator. A reference that is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. *In Re Roberston* 49 USPQ2d 1949 (1999).

5. Claims 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al. in view of Funaoka et al. and Narang et al., as applied to Claims 1-4, 6-9, 12-17, and 19, and further in view of Kaneko et al. (U.S. Patent No. 5,494,991 A).

Nakagawa et al., Funaoka et al., and Narang et al., teach the polymer electrolyte membrane as recited in Paragraph 4. However, Nakagawa et al., Funaoka et al., and Narang et al. fail to teach said polyimide constituting the microporous polyimide membrane comprises at least 1 mol% of 3,3'-dihydroxy-4,4'-diaminobiphenyl based on the total diamine component.

Kaneko et al. teach a polyimide polymer comprising up to 10% of 3,3'-dihydroxy-4,4'-diaminobiphenyl based on the total diamine component (col. 9, lines 8-45). It is advantageous to add 3,3'-dihydroxy-4,4'-diaminobiphenyl to the polyimide polymer because it will improve thermal dimensional stability and mechanical strength (col. 2, lines 1-11). Therefore, it would have been advantageous to one having ordinary skill in the art at the time the invention was made to create the microporous polyimide membrane of Nakagawa et al., Funaoka et al., and Narang et al. with up to 10% of 3,3'-dihydroxy-4,4'-

diaminobiphenyl based on the total diamine component because Kaneko et al. teach the additional polymeric component improves thermal dimensional stability and mechanical strength.

6. Claims 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al. in view of Funaoka et al. as applied to Claim 1-4, 6, 11, 14-17, and 19 above, and further in view of Ichino et al. (U.S. Patent No. 5,858,264 A).

Regarding Claims 18 and 20, Nakagawa et al. and Funaoka et al. teach the methods of producing a polymer electrolyte membrane as recited in Paragraph 2 above. However, Nakagawa et al. and Funaoka et al. fail to teach infiltration of the pores by either the molten salt or the mixture by vacuum degassing and/or pressurizing.

Ichino et al. teach a process for producing a polymer electrolyte membrane wherein the membrane is impregranted with the polymer via a vacuum treatment (col. 4, line 66 - col. 5, line 22). It is advantageous to impregnate the membrane with a vacuum treatment because it will remove the air from the pores (col. 5, lines 8-11). Therefore, it would have been obvious to one having ordinary skill in the art to use the process of producing a polymer electrolyte membrane of Nakagawa et al. and Funaoka et al. wherein a vacuum treatment is used to impregnate the polymer into the polymer electrolyte membrane because Ichino et al. teach the vacuum treatment impregnation will remove air from the pores of the membrane.

7. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al. in view of Funaoka et al., and further in view of Kim et al. (Solid State Ionics 144 (2001) 329-337).

Regarding Claim 21, Nakagawa et al. teach a process of producing a polymer electrolyte membrane containing a molten salt comprising by infiltrating the molten salt into pores of a microporous polymer membrane comprising immersing the microporous polymer membrane having pores in the molten salt (col. 10, lines 1-15) or impregnating the microporous polymer membrane having pores in a solution of the mixture of a polymer and a molten salt at a weight ratio of 1/9 and irradiating (drying) the membrane with an electron beam (col. 18, lines 3-14). A solvent may be used in the solution (col. 4, lines 36-64), and the solvent would dry when the electrolyte became in solid-state (col. 18, lines 13-14). Nakagawa et al. further suggest impregnation by dipping (immersing, col. 10, lines 12-15). However, Nakagawa et al. fail to teach said microporous polymer membrane has pores penetrating through the opposite sides thereof or that said solution of a mixture of a polymer and a molten salt is applied to both sides of the microporous polymer membrane.

Funaoka et al. teach a microporous membrane (abstract) that comprises through-holes in the membrane (col. 5, lines 8-11). It is advantageous to use the through-holes of Funaoka et al. because it retains high permeability (col. 5, lines 12-15). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to create the process of producing a polymer electrolyte membrane of Nakagawa et al. wherein the polymer membrane has pores penetrating through the opposite sides thereof

because Funaoka et al. teach that said through-holes will retain high permeability of the polymer electrolyte membrane.

Kim et al. teach a polymer electrolyte for a microporous membrane (abstract), wherein the membrane is coated on both sides with a polymer and soaked in an electrolyte solution to fill the pores (pg. 330). It is advantageous to coat the sides of the membrane because it will encapsulate the electrolyte solution in the porous membrane and further assist in adhering the electrodes to the separator (pg. 330). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to create the process of producing the polymer electrolyte membrane of Nakagawa et al. and Funaoka et al. wherein the membrane is coated on both sides with a polymer and soaked in an electrolyte solution to fill the pores because Kim et al. teach that encoating the sides with a polymer will encapsulate the electrolyte solution in the porous membrane and further assist in adhering the electrodes to the separator.

8. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakagawa et al. in view of Funaoka et al. in view of Kim et al. as applied to Claim 21 above, and further in view of Ichino et al. (U.S. Patent No. 5,858,264 A).

Regarding Claim 22, Nakagawa et al., Funaoka et al., and Kim et al. teach the method of producing a polymer electrolyte membrane as recited in Paragraph 7 above. However, Nakagawa et al., Funaoka et al., and Kim et al. fail to teach infiltration of the pores by either the molten salt or the mixture by vacuum degassing and/or pressurizing.

Ichino et al. teach a process for producing a polymer electrolyte membrane wherein the membrane is impregranted with the polymer via a vacuum treatment (col. 4, line 66 - col. 5, line 22). It is advantageous to impregnate the membrane with a vacuum treatment because it will remove the air from the pores (col. 5, lines 8-11). Therefore, it would have been obvious to one having ordinary skill in the art to use the process of producing a polymer electrolyte membrane of Nakagawa et al., Funaoka et al., and Kim et al. wherein a vacuum treatment is used to impregnate the polymer into the polymer electrolyte membrane because Ichino et al. teach the vacuum treatment impregnation will remove air from the pores of the membrane.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Zachary Best whose telephone number is (571) 270-3963. The examiner can normally be reached on Monday to Thursday, 7:30 - 5:00 (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dah-Wei Yuan can be reached on (571) 272-1295. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

zpb

/Dah-Wei D. Yuan/
Supervisory Patent Examiner, Art Unit 4191